Retrospective evaluation of poisonings in a pediatric intensive care unit: 4 years of experience

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Abstract

Aim: We defined clinical characteristics of patients admitted to the pediatric intensive care unit (PICU) with a diagnosis of poisoning. Material and Method: The study was designed as a retrospective, uni-center, cross-sectional study. All patients who were admitted to the PICU for poisoning by a chemical substance between December 2012 and June 2017 were included in the study. We recorded the frequency of patients admitted to the PICU with poisoning as well as their clinical characteristics. Results: Overall, 1093 patients were admitted to PICU during study period including 223 patients with poisoning due to chemical substances. The incidence of admissions due to poisoning was 11.7%. The poisoning was unintentional in 58.3% (n = 130) of patients, and it was associated with suicidal intent in 39.9% (n = 89) and substance abuse in 1.8% (n = 4). Neither clinical nor laboratory findings were observed in 69.5% (n = 155) of these patients. An antidote was used in 17.5% of patients, with N-acetyl cysteine being the antidote most commonly used. A combination of an analgesic-antitussive-decongestant was the most common agent (7.7%) resulting in poisoning. Colchicine intoxication was seen in 3.4% of patients, a markedly higher incidence than reported in the literature. Discussion: It is important to identify characteristics in poisoning as a basis for taking appropriate measures and developing treatment plans.

Keywords

Children; Etiology; Pediatric Intensive Care Unit; Poisoning

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Introduction

Poisoning is one of the most commonly encountered medical emergencies and is a common reason for emergency department visits and admissions to the intensive care unit. In 16 countries with high or medium income levels, poisoning was identified as the fourth leading cause of unintentional injury following motor vehicle accidents, fires, and drowning [1].

Poisoning is also the second leading cause of injuries requiring hospitalization in children younger than 5 years [2]. The mortality rate varies based on the causative agent, the dose, and patient characteristics [3].

Identifying clinical characteristics of patients admitted with a diagnosis of poisoning may contribute to the development of appropriate treatment measures. We identify clinical characteristics of patients admitted to the pediatric intensive care unit (PICU) with a diagnosis of poisoning as well as the frequencies of the chemical agents involved in the poisoning and the antidotes used.

Material and Method

This was a retrospective, single-center, cross-sectional study. All patients who were admitted to the PICU of Kayseri Training and Research Hospital between December 2012 and June 2017 for poisoning by a chemical substance were included in the study. The PICU of Kayseri Training and Research Hospital consists of 22 ICU beds, including 12 Level 3 and 10 Level 2 beds. The annual volume is approximately 340 patients.

The study was approved by the Clinical Research Board of Erciyes University School of Medicine (approval no. 2017/135). The study was exempted from obtaining patient consent because it was a retrospective study.

Eligibility criteria included age <18 years and admission to the PICU with a diagnosis of poisoning. Exclusion criteria included poisoning due to food or animals (e.g., a scorpion or snake bite). The diagnosis was made based on information obtained from the patient or caregivers regarding any history of ingestion of suspicious chemicals and clinical signs and symptoms.

Data were extracted from patient records and intoxication data sheets completed for all patients with chemical poisoning. Data regarding age, sex, body weight, dates of PICU admission and discharge, reason for ingestion (unintentional, suicidal intent, substance abuse), previous history of suicide attempt, history of psychiatric therapy, drugs ingested and their doses, presence or absence of gastric lavage and/or active charcoal administration, route of intake (oral, intravenous, inhalation), Pediatric Risk of Mortality (PRISM) and Glasgow Coma Scale (GCS) scores at presentation, administration of any antidote, use of mechanical ventilation, clinical and laboratory findings, and mortality were recorded on the intoxication data sheet.

The primary aim of this study was to determine agents that lead to poisoning in patients admitted to the PICU with a diagnosis of poisoning by a chemical substance. Secondary aims were to determine the frequency of admissions due to poisoning; the demographic, clinical, and laboratory findings of patients; the antidotes used; and the mortality rate. Data are presented as frequencies (%).

All statistical analyses were performed using IBM Statistics for Windows version 21.0. Normality was tested using the Kolmogorov–Smirnov test. Nonparametric data are presented as medians (25th–75th percentiles). Categorical data are presented as frequencies (%). A p-value <0.05 was considered to indicate statistical significance.

Results

Overall, 1093 patients were admitted to the PICU during the study period (December 1, 2012–June 1, 2017), including 223 patients with poisoning by chemical substances. The incidence of admissions to the PICU due to poisoning was 11.7%. During the same period, 1139 patients presented to the emergency department with poisoning by a chemical substance, but only 223 (19.57%) of these were admitted to the PICU.

In this study population, the median age was 154 (30–193) months, and the median body weight was 35 (13–54.7) kg. There were 131 girls (58.7%) and 92 boys (41.3%). The median age was 183 (143–195) months in girls and 40 (24–176) months in boys; it was 37 (25–63) months in patients with unintentional poisoning and 186 (178–198) months in patients who had attempted suicide ($p < 0.001$).

The GCS score at presentation was <8 in 12 (5.38 %) patients, 8–14 in 17.5%, and 15 in 77.1% (n = 172). The median PRISM score was 0 (0–8). The median length of ICU stay was 1 (1–2) day.

Poisoning was unintentional in 130 (58.3%) patients. It was associated with suicidal intent in 89 (39.9%) and with substance use in 4 (1.8%) of patients. Of all patients, 33 (14.8%) were receiving psychiatric therapy at the time of admission.

Of those diagnosed with poisoning accompanied by suicidal intent (n=89), 29 (32.6%) were receiving psychiatric therapy, 15 (16.9%) had at least one prior suicide attempt, and 19 (21.3%) had ingested prescribed medication in the suicide attempt.

Intake of multiple drugs was identified in 65 (29.1%) and intake of a single drug in 145 (65%); no information regarding the number of drugs taken was available for 13 (5.8%) of the study population. The rate of intake of multiple drugs was 46 (51.7%) among patients with suicidal intent compared to 22 (16.9%) among those with unintentional poisoning ($p < 0.001$).

The route of intake was oral in 214 (96%) of patients, inhalation in 7 (3.1%), and intravenous in 1 (0.4%). In 13 (5.8%) patients, no information was available on the causative agent, although a history of the poisoning event was taken. No gastric lavage was performed in 204 (91.5%) of patients, and no active charcoal administration was performed in 199 (89.2%). Of the study population, 4 (1.79%) required mechanical ventilation. Mechanical ventilation support was needed because of laryngeal edema from anti-lime intake in one patient, shock, and multiple organ failure due to colchicine and iron intoxication in two patients, and myocarditis and cardiac arrest due to lighter fluid inhalation in one.

Overall, three patients 3 (1.3%) died, including one patient who died from cardiopulmonary arrest caused by lighter fluid inhalation, one patient who died from hepatic and renal failure caused by massive oral iron intake, and one patient who died with multiple organ failure caused by colchicine intoxication.

Three patients 3 (1.3%) were transferred to another facility for treatment, including one patient who required plasmapheresis and two who required hyperbaric oxygen therapy.

Evaluation of the drugs that resulted in intoxication revealed 352 agents. The combination of an analgesic plus an antitussive plus a decongestant (7.7%; n = 27) was the most common agent resulting in intoxication, followed by paracetamol (6.8%; n = 24) and nonsteroidal anti-inflammatory drugs. The drug classes included CNS agents (23.3%), cardiovascular agents (15.6%), environmental poisons (3.4%), pesticides (2.3%), narcotics (1.1%), and analgesic-antipyretic agents and other pharmaceuticals (54.3%). Table 1 lists the drugs that resulted in intoxication in the study population.

An antidote was used in 17.5% of cases, with N-acetyl cysteine being the most commonly used antidote. Table 2 presents the antidotes used.

No clinical or laboratory findings were seen in 161 (72.2%) of patients, whereas both clinical and laboratory findings were observed in 14 (6.3%). Clinical findings alone were identified in 22 (9.9%) of patients, and laboratory findings alone were identified in 26 (11.7%). Table 3 shows the clinical and laboratory findings.

Table 1. Frequency of agents in poisoning

Agents causing poisoning	Count (%)
Poisoning with analgesics, anti-inflammatory agents, and other pharmaceuticals	191 (54.3)
Common cold drugs	27 (7.7)
Paracetamol	24 (6.8)
NSAİİ	23 (6.5)
Antibiotics	19 (5.4)
Colchicine	12 (3.4)
Muscle relaxants	9 (2.6)
Antihistamines	8 (2.3)
Antiulcer agents	8 (2.3)
Aspirin	7 (2)
Oral anti-diabetics	7 (2)
Oral iron preparations	6 (1.7)
Vitamin preparations	5 (1.4)
Anti-cholinergic agents	5 (1.4)
Thyroid and anti-thyroid agents	4 (1.1)
Theophylline	4 (1.1)
Anti-spasmodic agents	4 (1.1)
Anti-tussive	3 (0.9)
Anti-thrombotic agents	3 (0.9)
Isoniazid	2 (0.6)
Anti-emetic agents	2 (0.6)
Anti-asthmatic agents	2 (0.6)
Cholesterol lowering agents	2 (0.6)
Anti-neoplastic agents	1(0.3)
Others	4 (1.1)
Poisoning with neuropsychiatric agents	82 (23.3)
Antipsychotic agents	22 (6.3)
Tricyclic antidepressants	17 (4.8)
SSRIs	17 (4.8)
Anti-epileptic agents	12 (3.4)
Ergot alkaloids	6 (1.7)
Benzodiazepine derives	3 (0.9)
Sedative hypnotics and anxiolytic agents	2 (0.6)
Anti-Parkinson agents	1 (0.3)
Other neuropsychiatric agents	2 (0.6)
Poisoning with cardiovascular agents	55 (15.5)
Diuretic combinations	16 (4.5)
Beta-blockers	13 (3.7)
ACE inhibitors	8 (2.3)
ARB antagonists	8 (2.3)
Calcium channel blockers	6 (1.7)
Vasodilator agents	5 (1.4)
Anti-arrhythmic agents	2 (0.6)
Other	1 (0.3)
Environmental poisoning	12 (3.4)
Corrosive agents	4 (1.1)
Carbon monoxide	3 (0.9)
Yellow phosphorus (firework cracker)	2 (0.6)
Pain thinner	1 (0.3)
Cyanide	1 (0.3)
Ethyl alcohol	2 (0.6)
Methyl alcohol	1 (0.3)
Pesticide poisonings	8 (2.3)
Rat poison	4 (1.1)
Organophosphates	4 (1.1)
Narcotic poisoning	4 (1.1)
Lighter fluid	2 (0.6)
Bonzai	1 (0.3)
Hemp	1(0.3)
Total	352 (100)

Discussion

In the present study, PICU admissions for poisoning by chemical substances showed the following characteristics: Such poisonings were frequent, unintentional intoxication was the most common form of poisoning, an analgesic–antitussive–decongestant combination was the most common agent, N-acetyl cysteine was the most commonly used antidote, unintentional poisoning was more common among boys and adolescents, colchicine intoxication was more prevalent than previously reported in the literature, most cases had an asymptomatic course, the most common findings in symptomatic patients were cardiovascular in nature, and mortality was rare.

Poisoning is a significant cause of PICU admission and an important health issue in childhood. In ICUs, 5–30% of beds are used for poisoning cases [4]. In our study, 11.7% of ICU admissions were for poisoning by chemical substances.

Age and sex are the most important factors influencing the pattern of poisoning [4]. Poisonings are mostly unintentional, and they are more common in boys than in girls before adolescence. In girls, they are more commonly associated with suicidal intent during adolescence [5, 6].

A study by Andiran *et al.* [7] found that poisoning due to therapeutic errors was most common in children aged <1 year, unintentional intake was most common in children ages 1–5 years, and intake with suicidal intent was most common in children aged >10 years. A study by Ozdogan *et al.* [8] found that poisoning was most frequent between 13 months and 4 years of age. In agreement with the literature, the present study found that poisoning with suicidal intent was more common in adolescence and among girls, whereas unintentional poisoning was more common in boys and preadolescents.

In a study in Diyarbakır Province, Ozdogan *et al.* [8] found that unintentional poisoning was the most common cause of intoxication among cases presenting at the emergency department. Similarly, unintentional intake was the most common cause of poisoning in our study. No poisoning due to misuse of a therapeutic dose was observed in our study. In addition to poisoning with suicidal intent, we also observed cases of poisoning due

Table 2. Assessment of antidotes used

Name	n (%)
N-acetyl cysteine	20 (9)
Desferrioxamine	3 (1.3)
Physostigmine	3 (1.3)
Pyridoxine	2 (0.9)
Pralidoxime	2 (0.9)
Methylene blue	2 (0.9)
Cyproheptadine	1(0.4)
L-Carnitine	1(0.4)
Ethyl alcohol	1(0.4)
Flumazenil	1 (0.4)
Hydroxocobalamin	1 (0.4)
Vitamin K	1 (0.4)
Biperiden hydrochloride	1 (0.4)
Total	39 (17.5)

Table 3. Clinical and laboratory findings of patients.

Clinical and laboratory findings observed in patients	n (%)
Clinical findings	57 (25.5)
Hemodynamic, cardiac conduction and rhythm abnormalities	22 (9.87)
Hypotension	7 (3.14)
Tachycardia	6 (2.69)
Bradycardia	5 (2.24)
Hypertension	2 (0.9)
Arrhythmia	1 (0.45)
CNS findings	16 (7.17)
Altered mental status	4 (1.79)
Delirium	2 (0.9)
Convulsion	6 (2.69)
Dystonia	1 (0.45)
Headache	1 (0.45)
Gastrointestinal system findings	11 (4.93)
Nausea and vomiting	4 (1.79)
Other findings	8 (3.59S)
Urinary retention	1 (0.45)
Mydriasis	1 (0.45)
Dry mouth	2 (0.90)
Myosis	1 (0.45)
Allergy	1 (0.45)
Fever	1 (0.45)
Inspiratory stridor	
Laboratory findings	27 (12.11)
Hematological findings	7 (3.14)
Impaired coagulation tests	4 (1.79)
Thrombocytopenia	1 (0.45)
D-dimer elevation	1 (0.45)
Leukocytosis	1 (0.45)
Metabolic findings	7 (3.14)
Metabolic acidosis	3 (1.35)
Hypokalemia	3 (1.35)
Hyperglycemia	1 (0.45)
ECG abnormalities	7 (3.14)
QT prolongation	4 (1.79)
PR prolongation	1 (0.45)
QRS widening	1 (0.45)
Brunch block	1 (0.45)
Abnormal hepatic function tests	6 (2.69)
Abnormal renal function tests	4 (1.79)
Elevated muscle enzymes	1 (0.45)
Myoglobinuria	1 (0.45)

to substance abuse among adolescents. Poisoning with suicidal intent was more frequent in adolescents and showed a higher incidence in patients with psychiatric risk factors [9]. In our study, of patients diagnosed with poisoning with suicidal intent, 32.6% were receiving psychiatric therapy, 16.9% had at least one prior suicidal attempt, and 21.3% had ingested prescription medication in the suicide attempt. Thus, when considering prescribing psychiatric treatment, one should keep in mind that patients may attempt to poison themselves using prescription medication.

It has been reported that multiple drugs are ingested in the majority of poisoning cases [9]. However, intake of a single drug was observed in the majority of our patients. Intake of multiple drugs was more frequent in cases of poisoning with suicidal intent.

Studies by Ozdemir *et al.* [3] and Andiran *et al.* [7] found that analgesics were the most common drugs causing intoxication. In agreement with the literature, an analgesic–antitussive–antipyretic combination, paracetamol, and nonsteroidal anti-inflammatory drugs were the most common agents of intoxication in our study. Among CNS agents, antipsychotic agents were the leading cause of intoxication, followed by SSRIs and tricyclic antidepressants.

Colchicine intoxication is a rare and fatal form of poisoning. According to data from the American Association of Poison Control Centers, the incidence of colchicine intoxication is 0.0046% among children aged <19 years [10]. In our study, colchicine intoxication was observed in 3.4% of the patient population, a markedly higher rate than reported in the literature. This may be because of the higher incidence of Familial Mediterranean Fever in Turkey, for which colchicine is a common treatment.

In a study of patients who presented to the emergency department with poisoning in Eskisehir Province, Sahin *et al.* [11] reported that the incidence of corrosive agent ingestion was 21.3%, and carbon monoxide intoxication was the third leading cause of poisoning. In our study, the frequencies of corrosive agent ingestion and carbon monoxide intoxication were both low. This may be because of the practice of admitting only children with the potential for severe complications who require close monitoring to the ICU and admitting the majority of cases with corrosive agent ingestion or carbon monoxide intoxication to a regular ward.

In Turkey, volatile substances are the most commonly abused substances after alcohol and cigarettes because they are readily available, inexpensive, and fast acting [12]. In our study, two adolescent patients were admitted to the ICU for lighter fluid inhalation (butane). One of these patients died from myocarditis.

Another readily available environmental toxin is firework cracker, a kind of toy that contains yellow phosphorus, which can result in fatal poisoning. Yellow phosphorus is a potent local and systemic toxin that causes injury to the gastrointestinal

system, liver, cardiovascular system, and kidneys [13]. Unfortunately, firework cracker is readily available to children in Turkey. Our study population included two cases of poisoning caused by firework cracker. No impairment in clinical and laboratory parameters was observed in these patients during follow-up.

Currently, gastric lavage is not routinely recommended in poisoning cases. It may be considered only within the first 60 min after ingestion and in cases in which a potentially life-threatening amount of poison has been ingested [9, 14]. Because a broad spectrum of indications is used for gastric lavage in our hospital, gastric lavage was used in all patients except those with hydrocarbon or heavy metal poisoning. This may be because clinicians were concerned about legal liability if they did not use gastric lavage.

Antidotes are available for a limited number of substances causing intoxication, and timely administration of an appropriate antidote improves the clinical picture. However, many centers have problems with their supplies of antidotes [15]. In a study by Andiran *et al.* [7], an antidote was administered to 7.9% of patients who presented with poisoning. In our study, an antidote was given to 17.5% of patients, the most common being N-acetyl cysteine. Furthermore, antidotes were used in all poisonings for which they were indicated, and several antidotes were used without encountering any problems with supply.

Childhood poisoning cases may show an asymptomatic course, or minor symptoms may be observed [16]. In our study, the majority of patients were asymptomatic (69.5%). The most common clinical findings included hemodynamic abnormalities and cardiac conduction and rhythm disorders, followed by gastrointestinal findings. A shorter ICU stay was associated with high GCS and low PRISM scores at presentation as well as an asymptomatic course.

The mortality rate is low in cases of poisoning, and mortality is more commonly reported in children aged <6 years [6]. In a study of emergency department patients, Andiran *et al.* [7] reported a mortality rate of 0.4%. In our study, only three patients did not survive; one patient with disseminated intravascular coagulation caused by massive iron intoxication, one with multiple organ failure caused by colchicine intoxication, and one with myocarditis and cardiopulmonary arrest caused by lighter fluid inhalation. Colchicine intoxication is one of the most severe forms of poisoning, and doses of colchicine >0.8 mg/kg are considered lethal [10]. In Turkey, colchicine is marketed in 0.5 mg tablets and sold in cartoon blister packaging. Unintentional intoxication is frequent in younger children, as colchicine is commonly used to treat familial Mediterranean fever and is marketed without safety packaging. In our study, a 3-year-old girl ingested colchicine at a dose >0.8 mg/kg. The rapid development of multiple organ failure and collapse was observed, eventually resulting in death despite plasmapheresis.

A study by Ozdemir *et al.* [3] found that mortality was higher in cases of poisoning with a nontherapeutic substance compared to poisoning with medication. In our study, no mortality was observed in patients intoxicated by chemical substances except one patient poisoned by lighter fluid. Ingestion of highly alkaline or acidic substances is a major cause of morbidity and mortality worldwide, particularly in developing regions [17]. In our study, a 3-year-old girl unintentionally ingested anti-lime solution. Respiratory arrest and subsequent cardiac arrest developed due to laryngeal edema, and the patient required mechanical ventilation via tracheostomy.

Limitation of the study is the retrospective design and the low number of the patients.

In conclusion, admission to the PICU for intoxication with chemical substances is rather frequent. Although the majority of patients are asymptomatic, mortality is not rare. Understanding the clinical characteristics of patients admitted to the ICU for poisoning is beneficial to the process of establishing appropriate treatment measures.

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Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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